APPENDIX NOT INCLUDED

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REMEDIAL INVESTIGATION AND FEASIBILITY STUDY (RI/FS) WORK PLAN

FOR THE
GULFCO MARINE MAINTENANCE
SUPERFUND SITE
FREEPORT, TEXAS

PREPARED BY:

Pastor, Behling & Wheeler, LLC
2000 S. Mays Suite 300
Round Rock, Texas 78664
(512) 671-3434

OCTOBER 6, 2005

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1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. in Freeport, Brazoria County, Texas (the Site) to the National Priorities List (NPL) in May 2003. The EPA issued a modified Unilateral Administrative Order (UAO), effective July 29, 2005, requiring the Respondents to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. This RI/FS Work Plan (RI/FS WP) was prepared in accordance with Paragraphs 21 through 24 of the Statement of Work (SOW) for the RI/FS, included as an Attachment to the UAO. The RI/FS WP was prepared by Pastor, Behling & Wheeler, LLC (PBW), on behalf of LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy) and The Dow Chemical Company (Dow) (collectively referred to as Respondents in the UAO). Figure 1 provides a map of the site vicinity, while Figure 2 provides a detailed site map.

1.1 PROBLEMS POSED BY THE SITE

Site investigations performed by the Texas Natural Resource Conservation Commission (TNRCC), now known as the Texas Commission on Environmental Quality (TCEQ), in 2000 and 2001 (see Section 2.2.2 for investigation details) indicated that several contaminants were present at concentrations above background levels in soil, groundwater and sediment samples (TNRCC, 2000a and 2002). The HRS Documentation Report (TNRCC, 2002) concluded that these data “indicated observed releases along the Surface Water Migration Pathway” and that these observed releases were attributable to sources at the Gulfco facility. A Public Health Assessment (PHA) performed for the Site by the Texas Department of Health (TDH) for the Agency for Toxic Substances and Disease Registry (ATSDR) (TDH, 2004) concluded that contaminants in soil, sediment and groundwater pose no apparent public health hazards, but the overall public health hazard could not be determined due to a lack of data for all pathways. TDH recommended that a remedial investigation of the Site be performed. The overall problem to be addressed by the RI/FS is to evaluate the nature and extent of contamination at and from the Site, assess the risk from this contamination to human health and the environment, and evaluate potential remedial alternatives.

1.2 OBJECTIVES

Consistent with the overall problem posed by the Site and EPA guidance, the specific objectives of this RI/FS are to: (1) characterize site conditions; (2) evaluate the nature and extent of the contamination; (3) assess the risks to human health and the environment; (4) identify remedial action objectives for those chemicals and media posing an unacceptable risk; (4) develop preliminary remediation goals (PRGs) to address the remedial action objectives; (5) develop, screen and evaluate potential remedial technologies consistent with the PRGs; (6) examine the potential performance and cost of the remedial alternatives that are being considered; and (7) select the appropriate alternative for site remediation. The RI/FS process is a phased, interactive, and iterative process. The RI and FS are conducted concurrently, and data that are collected in the RI influence the development of remedial alternatives in the FS, which in turn affects the data needs and scope of treatability studies and additional field investigations.

The objective of the RI/FS WP is to document the decisions and evaluations made during the RI/FS scoping process and present a summary of the work to be performed during the RI/FS. The work plan also presents the initial evaluation of existing Site data and background information, and describes the project management team and schedule.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

2.1 SITE DESCRIPTION

The Site is located about three miles northeast of Freeport, Texas in Brazoria County at 906 Marlin Avenue (also referred to as County Road 756) (Figure 1). The Site consists of approximately 40 acres within the 100-year coastal floodplain along the north bank of the Intracoastal Waterway between Oyster Creek to the east and the Old Brazos River Channel to the west.

The Site is located between Galveston and Matagorda Bays and is situated along approximately 2000 feet (ft.) of shoreline on the Intracoastal Waterway. The Intracoastal Waterway is a coastal shipping canal that extends from Port Isabel to West Orange on the Texas Gulf Coast. Approximately 78 people (17.9% minority and 23.3% economically stressed) live within the one square mile area surrounding the Site (EPA, 2005a). Approximately 3,392 people (33.4 % minority and 24.3% economically stressed) live within 50 square miles of the Site (EPA, 2005a).

2.1.1 <u>Environmental Setting</u>

Marlin Avenue divides the Site into two primary areas (Figure 2). For the purposes of this work plan, it is assumed that Marlin Avenue runs due west to east. The property to the north of Marlin Avenue (the North Area) consists of undeveloped land and the closed surface impoundments, while the property south of Marlin Avenue (the South Area) was developed for industrial uses with two barge slips connected to the Intracoastal Waterway, and will continue to be used for commercial/industrial purposes in the future. Adjacent property to the north, west and east of the North Area is unused and undeveloped. Adjacent property to the east of the South Area is developed and currently used for industrial purposes while to the west the property is currently vacant and previously served as a commercial marina. The Intracoastal Waterway bounds the Site to the south.

The South Area includes approximately 20 acres of upland that was created from dredged material from the Intracoastal Waterway. Some of the North Area is upland created from dredge spoil, but most of this area is considered wetlands (Figure 3). According to the National Wetlands Inventory map for the Freeport Quadrangle, the wetlands on and north of the Site are estuarine, intertidal, emergent, persistent, and irregularly flooded. Based on field observations, the North Area is tidally connected to Oyster Creek and the Intracoastal Waterway through a natural swale (draining northeast) and stormwater ditches north of the Marlin Avenue roadbed.

The South Area contains very little undisturbed habitat and resident wildlife is probably scarce. Shorebirds have constructed nests on some of the vertical structures at the Site, but there is no evidence that the Site is consistently being utilized by wildlife that would be common in undisturbed coastal habitat.

The Intracoastal Waterway supports barge traffic and other boating activities. The area near the Site is regularly dredged and, as noted by the United States Fish and Wildlife Service (USFWS), shoreline habitat is limited (USFWS, 2005).

Threatened and Endangered Species for Brazoria County include: bald eagle (*Haliaeetus leucocephalus*), black rail *(Laterallus jamaicensis*), eastern brown pelican (*Pelecanus occidentalis occidentalis*), interior least tern (*Sterna antillarum athalassos*), piping plover (*Circus melodus*), reddish egret (*Falco rufescens*), swallow-tailed kite (*Elanoides forficatus*), white-faced ibis (*Plegadis chihi*), wood stork (*Mycteria Americana*), and corkwood (*Leitneria floridana*) (TPW, 2005). None of these species have been noted at the Site but they are known to live in or on, feed in or on, or migrate through the Texas Gulf Coast and estuarine wetlands.

2.1.2 Hydrogeologic Framework

The Site geology consists predominantly of Quaternary alluvium and “fill and spoil” from the construction of the Intracoastal Waterway (Barnes, 1987), as shown on Figure 4. The alluvium consists of clay, silt, sand and gravel, with organic material abundant in the soils. The fill and spoil material consist of dredged material “for raising land surface above alluvium and barrier island deposits and creating land” (Barnes, 1987). The spoil material is highly variable with mixed mud, silt, sand and shell, with the reworked spoil mostly sandy and moderately sorted (McGowen, 1976).

Underlying the alluvium unit is the Beaumont Formation, which consists of clayey soils with interconnected, alluvial sand channels and barrier island beach deposits encountered in the formation. The Beaumont Formation is about 100 feet thick. The Lissie and Willis Formations underlie the Beaumont Formation. The Lissie Formation consists of interbedded sands, silts, and clays and is about 200 feet thick, overlying the Willis Formation, which consists of gravel, sand silt, and clay. The Alta Loma Sand is part of the Willis Formation and is the thickest sand sequence in the Willis Formation. The base of the Alta Loma Sand in southeast Brazoria County is about 1,200 feet below mean sea level (MSL) (Sandeen, 1982).

The Goliad and Fleming Formations underlie the Willis Formation. The Goliad and Fleming Formations consist of clay, sand, and sandstone interbeds, with some occasional limestone encountered in the Goliad Formation. The sands consist of medium to coarse grained quartz and chert (Barnes, 1987).

The two primary hydrogeologic units beneath the Site are the Chicot and Evangeline Aquifers. The Chicot consists of the Willis, Lissie, and Beaumont Formations. The Evangeline Aquifer consists of sands of the Goliad and Fleming Formations. The Chicot Aquifer is subdivided into two zones: the Lower and Upper Chicot. The Lower Chicot in Brazoria County generally includes the Alta Loma Sand unit, which is about 400 feet thick in the Freeport area (Sandeen, 1987). The Upper Chicot is made up of interconnected sands that are found within 300 feet below ground surface.

The main source of groundwater in the area is from the Chicot Aquifer. The Lower Chicot can produce as much as 3,000 gallons per minute (gpm); however the water is slightly saline (1,000 to 3,000 mg/L total dissolved solids (TDS)). The Upper Chicot is the most-widespread fresh-water aquifer in Brazoria County, and wells completed in Upper Chicot sands at least 50 feet thick can yield 500 to 1,000 gpm. However, in some areas along the coast interbedding of saline water with fresh water has been encountered (Sandeen, 1987).

The City of Freeport and Oyster Creek (located approximately four miles northwest of the Site) currently receive their water supply from surface water reservoirs north of those cities. Drinking water wells are prohibited within the city of Oyster Creek (Guevara, 1989). In 1989, the town of Surfside, located south of the Intracoastal Waterway, was dependant upon groundwater for their water source (EEI, undated b). The Site and vicinity currently receive water via pipeline from the City of Freeport. During the early operation at the Site, water was supplied for barge cleaning operations by two on-site water wells. It was reported that one of these wells was located adjacent to the front entrance gate south of Marlin Avenue (TNRCC, 2000b); however, neither of these wells could be located in July 2005. An updated water well inventory, including attempts to field locate identified wells, is proposed as Subtask 6.4 of the site characterization scope of work (see Section 5.6.4).

The closest water well (TWDB ID 81-06-303) identified near the Site is located on the adjacent property west of the Site at a former marina (see discussion in Section 2.21). The total depth of the well is reported to be 199 feet below ground surface. Water quality from the well in 1969 showed a TDS concentration of 1,382 mg/L with the depth to water about 67 feet (TWDB, 2005). In July 2005, this well was observed to be present, but not functional.

The previous monitoring wells installed at the Site were installed in shallow water-bearing sands less than 50 feet below ground surface. Three monitoring wells, HMW-1, HMW-2, and HMW-3 (Figure 2) that were installed in January 1989 (see discussion in Section 2.2.2) were completed in a sand unit about nine feet thick, with the top of the sand encountered about nine feet below ground surface (Hercules, 1989a).

2.2 SITE HISTORY

2.2.1 Operational History

A detailed understanding of the Site's operating history was developed through historical aerial photographs (1944,1965, 1977, 1985, 1987, 1995, 2000, and 2004), personnel interviews, operating information from air permit applications, investigation report summaries, and regulatory agency correspondence, inspection reports and memoranda/communication records. Mr. Billy Losack of LDL was an invaluable resource in this effort. Mr. Losack initially worked at the Site during the 1960s and later directed the dismantling and removal of many Site structures, operational equipment and appurtenances during 1999 and 2000 after LDL acquired the Site. Mr. Losack's personal familiarity with the Site was augmented by his multiple discussions during the structure/equipment dismantling work with personnel directly involved in the day-to-day operations of Site facilities. PBW reviewed historical aerial photographs and site maps/process diagrams from air permit applications with Mr. Losack to identify various Site features during its operational history.

Key activities during the operational history of the Site are summarized in Table 1. Historical aerial photographs documenting Site operations are provided in Appendix A to this work plan. For the purposes of the discussion below, the operational history has been divided into the following periods:

- Pre-barge cleaning operations (prior to 1971);
- Gulfco Marine Maintenance, Inc. (Gulfco) Operations (1971 – 1979);
- Fish Engineering and Construction, Inc. (Fish) Operations (1979 – 1989);
- Hercules Offshore Corporation and later Hercules Marine Services (collectively referred to as Hercules) Operations (1989 – 1999); and
- LDL Ownership (1999 to present).

The majority of the Site, including Lots 21 through 25, and Lots 55, 57, and 58 (see Figure 2 for approximate lot boundaries) are currently owned by LDL. Lot 56 was not sold to Hercules by Fish in 1989, but was deeded to Jack Palmer and Ron Hudson in 1999.

Pre-barge Cleaning Operations

The earliest historical photograph of the Site vicinity that could be obtained by PBW was for 1944. This photograph shows the Intracoastal Waterway south of the Site with what appear to be a sloping and somewhat eroded shoreline north of the waterway. Marlin Avenue is not present in this photograph; however, a significant linear feature is apparent in the northern part of the Site. This feature may be associated with dredge spoiling activities in the area as the northern boundary of the feature corresponds to the present location of a berm/ditch system that functions as a drainage divide at the Site (the feature is apparent in all subsequent aerial photographs and was observed in July 2005). The light-colored area south of the berm/ditch system may correspond to dredged material being free spoiled south of the berm. Spoil from the Intracoastal Waterway can be seen in the southern part of the Site. The presence of spoil material in this area immediately north of the Intracoastal Waterway is consistent with the designation of “fill/spoil” on the regional geologic map discussed in Section 2.1.2. In addition, deed records for specific lots on the Site (Brazoria County, 1936, 1937, and 1939) conveyed an easement to United States of America for the work of “constructing, improving, and maintaining an Intracoastal Waterway”, and for “the deposit of dredged material.”

The berm/ditch feature and Marlin Avenue are visible in the 1965 photograph of the Site area. The previously sloping north shore of the Intracoastal Waterway appears as a distinct upland area and a canal and future boat slip/marina area is present on the adjacent property to the west of the Site. Mr. Billy Losack (Losack, 2005) indicated that various welding activities were occasionally performed in the northeast part of the Site south of Marlin Avenue, approximately where the light colored ground surface is indicated on the 1965 aerial photograph. Temporary welding work was performed in this area; raw material and supplies were brought onto the Site, the work was performed and the finished products and any unused materials/supplies were removed from the Site. As supported by the 1965 photograph, no permanent structures were associated with those operations.

Gulfco Marine Maintenance, Inc. Operations

As noted in Table 1, Gulfco operated a barge cleaning facility on the Site from 1971 to 1979. As part of this operation, product heels were recovered from the barges and the barges were cleaned of waste oils, caustics and organic chemicals. Wash waters from the barge cleaning were stored in three surface impoundments in the North Area. The impoundments were described as earthen lagoons with a natural clay liner (TNRCC, 2000a) and were reportedly 3 feet deep (Guevara, 1989). Discharges from the impoundments in July 1974 and August 1979 reportedly “contaminated surface water outside of ponds” and “damaged some flora north of the ponds” (EPA, 1980).

Site features at the time of Gulfco’s operations at the Site are illustrated by a 1977 aerial photograph. This photograph shows two barge slips along the Intracoastal Waterway, including a barge within Barge Slip 2, and two other barges staged on the shoreline near the Site. A dry dock area used for barge repair, the Site office, shop and lunch room areas are present in the South Area. A fresh water tank (identified based on Losack, 2005) and several other storage tanks are visible adjacent to Barge Slip 2 in the photograph. The three surface impoundments are present in the North Area. The path of a pipeline from the tank area to the impoundments is projected on the 1977 photograph. It is assumed that a pipeline was the most likely means for transporting wash waters from the Barge Slip 2/tank area to the impoundments. The northern end of this pipeline was observed during a July 2005 site visit at the approximate location indicated on the photograph. The remaining path of the pipeline and its presence in 1977 are projected but have not been confirmed.

Several noteworthy features on adjacent or nearby properties are also apparent on the 1977 photograph. A commercial marina with covered boat slips and several other surface structures is visible on the property immediately west of the Site. Other undetermined industrial development is indicated on the property east of the Site with a tank battery located approximately 500 feet east of the Site boundary.

Fish Engineering and Construction, Inc. Operations

Fish purchased the Site and barge cleaning operation from Gulfco on November 12, 1979. Fish’s operations were similar to Gulfco. Chemical barges were drained and product heels were removed. Barges were washed with hot water and/or detergent solution and air dried prior to any repair work (welding and sandblasting). Barge heels were stored in small tanks to be sold for reuse and recovery. Wash waters were stored in impoundments and eventually sent off-site for deep well injection at Empark in Deer Park, Texas. The impoundments were taken out of service on October 16, 1981 and wash waters were stored in tanks or floating barges thereafter (TNRCC, 2000a).

The surface impoundments were closed in accordance with a Texas Water Commission-approved plan, with closure certification provided on August 24, 1982 (Carden, 1982). Impoundment closure activities involved removal of liquids and most of the impoundment sludges prior to closure. The sludge that was difficult to excavate (approximately 100 cubic yards of material) was solidified with soil and left mainly in Impoundment 2 (the larger impoundment shown to the east in the 1977 photograph) (Guevara, 1989). The impoundments were capped with three-feet of clay and a hard-wearing surface.

Site features at the time of Fish's operations at the Site are illustrated by aerial photographs from 1985 and 1987. Both of these photographs show the former surface impoundments capped and closed. A large barge, presumably used for wash water storage is located in the eastern half of Barge Slip 2. The dry dock, office, shop, lunchroom/restroom and storage tank areas are visible in the South Area in these photographs. A Quonset hut (used for general storage according to Losack, 2005), electrical shed, and concrete laydown areas are also apparent south of Marlin Avenue. Tank designations and other details noted on these figures (e.g., Water Heater) were determined from comparisons to site maps and process flow diagrams information in Fish's air permit exemption application (Fish, 1982) and discussions with Billy Losack (2005). Three product storage tanks shown on the permit application maps immediately south of the former surface impoundments can be seen on both the 1985 and 1987 photographs. Six wash water tanks, also described in an air permit exemption application (Fish, 1982) are visible in the southeastern part of the Site in the 1987 photograph. The Fresh Water Pond, reportedly created by the excavation of clay soils for the former surface impoundment cap, and a second pond also north of Marlin Avenue are clear on both photographs. Other areas, such as the employee parking area north of Marlin Avenue, sand pot and air compressor locations, and the two septic tank areas south of Marlin Avenue are labeled on the 1985 photograph based on Losack, 2005. It appears that the septic tanks directly north of the former shop area were observed by TNRCC in 2000 (Photograph 4 in TNRCC, 2000b). As for the 1977 aerial, the pipeline shown running from the Barge Slip 2/tank area to the former surface impoundments location is a projection, both in terms of its path and its presence in 1985 and 1987.

Off-site features are visible on the 1985 photograph, but due to poor photograph quality are not as apparent in the 1987 photograph. The commercial marina is present on the adjacent property to the west; however, the boat slip cover structure is not present and several boats are visible within the marina. The industrial operations to the east of the Site in 1985 appear relatively unchanged from 1977.

Hercules Offshore Corporation Operations

Hercules purchased the Site (except for Lot 56) and barge cleaning operation from Fish on January 20, 1989. Hercules operations included barge cleaning and repair. Product heels were removed from barges into aboveground storage tanks (ASTs) and subsequently sold as product. Barges were washed with water and detergent. Wash waters were stored in storage tanks and then either transported to an off-site injection well or transported to Empark in Deer Park, Texas (TNRCC, 2000a). Mickey Tiner, a project manager for Hercules from February 1990 to September 1991, indicated in an interview with TNRCC personnel (TNRCC, 1997) that Hercules discharged wastewater from barge cleaning operations directly into the Intracoastal Waterway at night while he was at the facility. To address concerns over fugitive dust emissions associated with sand blasting operations at the Site, Hercules erected a dust control screen on the western boundary of the South Area. Hercules filed for Chapter 7 bankruptcy on May 4, 1998.

Site features at the time of Hercules' operations at the Site are illustrated by an aerial photograph from 1995. No barges are visible in this photograph; however, the dry dock, office, shop, Quonset hut, electrical shed, lunchroom/restrooms and concrete laydown areas visible in previous aerial photographs can be seen. The AST tank farm area appears to be surrounded by a containment wall in 1995. Two sand blasting operation areas south of Marlin Avenue are more clearly visible in 1995 than in previous photographs, but it is uncertain whether this is due to increased operations or the quality of the 1995 photograph. Only two of the six wash water tanks visible in the 1987 photograph are apparent in 1995. A pipeline running from the southern end of the former AST Tank Farm containment area to the Intracoastal Waterway has been plotted on the 1995 aerial photograph. Mr. Billy Losack (Losack, 2005) indicated that he removed this pipeline as part of Site structure/equipment dismantling activities performed after acquisition of the Site by LDL. The location where the northern end of the pipeline penetrated the former AST tank farm containment area wall was observed during a July 2005 site visit.

The commercial marina located immediately west of the Site appears to have ceased operations in the 1995 photograph. In contrast, the industrial operations to the east have expanded as indicated by a new boat slip/dock area and AST immediately adjacent to the Site.

LDL Ownership

LDL acquired the Site (except for Lot 56) from the bankruptcy court on August 2, 1999. Under LDL's direction, most Site and equipment were removed from the Site during the initial four months of LDL's ownership (approximately August through November, 1999). In April 2002, LDL leased part of the Site to Eco-Terra Technologies Group, LLC (ET) who had obtained a Texas Railroad Commission permit to set-up a crude oil recycling operation. ET modified some of the tankage and piping in the former AST Tank Farm area to support this operation, but according to Losack, 2005, only about seven truckloads of crude oil were ever shipped to the Site. This material was subsequently removed from the Site and ET ceased operations and left the Site after approximately five months.

Site features at the approximate time that LDL acquired the Site are illustrated by an aerial photograph from 2000. This photograph is very similar to the 1995 photograph with a key difference being the removal of all of the former wash water tanks from the southeastern corner of the Site. In contrast, a 2004 aerial photograph shows a significant change, with all structures removed from the Site, except for the electrical shed and tanks in the former AST tank farm area.

2.2.2 Investigation History

Previous investigations at the Site included the following:

- **Surface Impoundment Groundwater Monitoring Wells (1982)** – In conjunction with closure of the former surface impoundments in 1982, Fish installed four monitoring wells on the perimeter of the impoundments. All four wells were screened from 38 to 48 feet below grade and were sampled at least four times from July 1982 through September 1982. Samples were analyzed for benzene, phenols, total dissolved solids (TDS), conductivity, pH, and total organic carbon (TOC) and concentration data reported to the TWC included: benzene – 1 ug/L to 8,180 ug/L; TDS – 34,000 mg/L to 53,000 mg/L; phenols - <10 ug/L to 1,092 ug/L; and TOC – 60 ug/L to 290 ug/L. Total organic halogens (TOX) analyses were attempted but abandoned due to reported interferences from high inorganic chlorides. The wells were reportedly plugged in December 1983 (TNRCC 2000a).

- **Surface Impoundment Groundwater Monitoring Wells (1989**) – In January 1989, Pilko Associates installed three monitoring wells around the perimeter of the former surface impoundments. The approximate locations of these wells, designated as HMW-1, HMW-2, and HMW-3 are shown on Figure 2. The wells were completed from 8 to 18 feet below grade (Hercules, 1989a). Soil samples were collected from the borings used to install the wells and groundwater samples were collected following well completion. These data are discussed in Section 3.1, below. During a site visit in April 2005, the wells were located in the field and were not locked, but did not appear to be damaged.

- **Groundwater Monitoring Wells (the South Area)** – Three permanent monitoring wells (PVC well casing, outer steel protective casing) are present in the South Area (MW-1, MW-2 and MW-3 on Figure 2). The construction details and installation dates for these wells are not known, although the total depths are reported to range from 15.2 to 20.3 feet below grade (TNRCC, 2000a). The wells were sampled by LT Environmental, Inc. (LTE) in 1999 and the TNRCC in 2000. During a July 2005 site visit, the wells were not locked and the surface completions of some of the wells appeared damaged.

- **ECM Phase I and II Investigations (1998 - 1999)** – According to LTE (1999), ECM & Associates (ECM) performed Phase I and II investigations at the Site that were summarized in a Phase II Sampling Report dated January 27, 1999. This report is not available and thus the scope and conclusions can not be confirmed. LTE (1999) noted several ECM investigation findings that served as a basis for subsequent site characterization work performed by LTE.

- **LTE Site Characterization (1999)** – In March 1999, LTE performed a series of investigation activities at the Site, including sampling AST and drum contents, accumulated water within the former AST tank farm containment area, soils, residual sandblasting material, sediment from the Fresh Water Pond, and groundwater. Groundwater samples included samples from temporary monitoring wells installed by LTE and samples from previously existing wells

MW-1, MW-2, and MW-3 south of Marlin Avenue. The LTE investigation locations are shown on Figure 2. Investigation findings are described in Section 3.1.

- **<u>TNRCC Screening Site Inspection (2000)</u>** – In cooperation with the EPA, TNRCC performed a Screening Site Inspection (SSI) at the Site in 2000 (TNRCC, 2000a). The SSI included collection of on-site and off-site soil samples, Intracoastal Waterway sediment samples (adjacent to and distant from the Site), Pond sediment samples and groundwater samples from existing monitoring wells MW-1, MW-2 and MW-3. On-site SSI investigation locations are shown on Figure 2. Investigation findings are described in Section 3.1.

- **<u>TNRCC Expanded Site Inspection 2001</u>** –In cooperation with EPA, TNRCC performed an Expanded Site Inspection (ESI) in January 2001. The ESI included collection of groundwater samples from temporary on-site and off-site monitoring wells. Although a separate ESI report was not prepared, the findings of the ESI were included in the Hazard Documentation Record (HRS) prepared for the Site by TNRCC (TNRCC, 2002). On-site ESI investigation locations are shown on Figure 2. Investigation findings are described in Section 3.1.

3.0 INITIAL EVALUATION

3.1 EXISTING DATA

The environmental data from the previous site investigations described in Section 2.2.2 were evaluated to provide a preliminary indication of Site conditions. Soils data from these investigations are provided in Tables 2, 3 and 4. Groundwater data are provided in Tables 5, 6, and 7. Surface water data are provided in Table 8. Sediment data are provided in Tables 9, 10 and 11. On-site sample locations are shown on Figure 2.

As detailed in Appendix A of the Draft Screening Level Ecological Risk Assessment (SLERA) (PBW, 2005b), environmental data from the 1999 LTE Site Characterization (LTE, 1999) were validated and found to be of sufficient quality for an initial evaluation. TNRCC SSI and ESI data were validated by an agency contractor as detailed in supporting documentation for TNRCC, 2002. Data flags associated with these validation procedures have been included with the data presented in Tables 2 through 11. Soil and groundwater data associated with the Hercules monitoring wells installed in 1989 (Hercules, 1989b) have also been included in these tables but could not be validated due to a lack of documentation.

Preliminary screening values (PSVs) for compounds detected in each sample matrix (soil, groundwater, surface water or sediment) are provided in the data tables associated with each sample matrix. These PSVs were used as the basis for the initial evaluation of existing data as outlined below. The detailed description of the process used to identify PSVs for each sample medium is provided in Section 5.6.

3.1.1 <u>Soils in North Area</u>

Existing soil data from the North Area of the Site were compared to PSVs developed in consideration of ecological and human health-based criteria. As indicated in Tables 2 through 4, the following exceedences of PSVs and background values (where background values were developed) were noted for the existing soil samples from this area: arsenic – four samples (three associated with the unvalidated Hercules, 1989b data); cadmium – three samples (all from Hercules, 1989b); chromium – two samples (all from Hercules, 1989b); lead – six samples (one from Hercules, 1989b, three J-flagged as estimated values); manganese – one sample; selenium – three samples; zinc – one sample (J-flagged as an estimated value); benzo(a)anthracene – one sample; benzo(b)fluoranthene – one sample; benzo(a)pyrene – one sample; dibenzo(a,h)anthracene – one sample (estimated value with reported concentration below the contract required quantitation limit (CRQL)); and dieldrin – one sample (estimated value flagged as biased high). No VOC exceedences were noted in any of these samples.

3.1.2 Soils in South Area

Consistent with the limited potential habitat for ecological receptors associated with the South Area of the Site, as described in Section 2.2.1, existing soil data from this area were compared to human health-based PSVs and background. As indicated in Tables 2 through 4, the following exceedences of PSVs and background values (where background values were developed) were noted for the existing soil samples from this area: arsenic – one sample; and benzo(a)pyrene – one sample (estimated value with reported concentration below the CRQL). No volatile organic compound (VOC) exceedences were noted in any of these samples.

3.1.3 Groundwater

Existing groundwater data were compared to PSVs developed in consideration of ecological and human health-based criteria. As indicated in Tables 5 through 7, the following exceedences of PSVs and background values were noted for the existing groundwater samples: copper – eight samples; lead – four samples; nickel – four samples; zinc – six samples; benzene – three samples; 1,2-dichloroethane (1,2-DCA) – three samples; 1,1-dichloroethene (1,1-DCE) – four samples; cis-1,2-dichloroethene (cis-1,2-DCE) – one sample; 1,2-dichloropropane – two samples; methylene chloride – three samples; tetrachloroethene (PCE) – one sample; 1,1,1-trichloroethane (1,1,1-TCA) – four samples; trichloroethene (TCE) – one sample; vinyl chloride – four samples; anthracene – one sample; gamma-BHC (Lindane)- three samples; 4-4-DDT – one sample; dieldrin – one sample; endosulfan – one sample; endrin – two samples; fluoranthene – one sample; helptachlor – one sample; heptachlor epoxide – one sample; phenanthrene – one sample; and pyrene – one sample. As noted in Tables 5 and 6, a number of the VOC and semi-volatile organic compound (SVOC) exceedences were reported as estimated values with some reported concentrations below the CRQL. Most of the exceedences, particularly the VOCs, were associated with samples collected in the immediate vicinity of the former surface impoundments.

3.1.4 Surface Water

Existing surface water data were compared to PSVs developed in consideration of ecological and human health-based criteria. Existing surface water data include one sample collected from each of the two ponds in the North Area and two samples of water accumulated within the former AST tank farm containment area. These samples were collected by LTE and were analyzed for VOCs only. As shown on Table 8, no PSVs were exceeded in these samples.

3.1.5 Sediments

Existing sediment data include samples from the Intracoastal Waterway adjacent to the Site (Site samples), samples from the Intracoastal Waterway distant from the Site (off-site samples), samples from the ponds north of Marlin Avenue (on-site Pond samples), and background samples from the Intracoastal Waterway. These data were compared to PSVs developed in consideration of ecological and human health-based criteria. As indicated in Tables 9 through 11, the following exceedences of PSVs and background values were noted for the existing Site sediment samples: lead – one sample; zinc – two samples; acenapthene – one sample; anthracene – one sample; benzo(a)anthracene – one sample; benzo(a)pyrene – one sample; bis(2-ethylhexyl)phthalate – three samples; chrysene – one sample; fluoranthene – one sample; fluorene – one sample; phenanthrene – two samples; and pyrene – one sample. As noted in Table 11, a number of the SVOC exceedences were reported as estimated values with some reported concentrations below the CRQL. Most of the exceedences, particularly the SVOCs, were associated with sample SE-8 collected near the northern end of Barge Slip 1 (Figure 2).

3.2 POTENTIAL SOURCE AREAS

Thirteen Potential Source Areas (PSAs) were identified at the Site based on the Site operations history, previous investigations and existing data as described above. These PSAs and their associated Chemicals of Interest (COIs) are listed in Table 12 and are shown on Figure 5.

3.3 CONCEPTUAL SITE MODEL

Separate preliminary Conceptual Site Models (CSMs) were developed for both human health and ecological receptors for the South Area and the North Area. The primary reason, however, for developing separate CSMs for the North and South Areas is because of the industrial nature of the South Area, which precludes it from ecological evaluation. The South Area does not provide suitable ecological habitat, and the potential for human health exposure varies between the North and South Areas (i.e., trespasser vs. industrial worker scenarios, respectively).

A CSM identifies exposure pathways for potentially complete pathways at the Site and describes the process or mechanism by which human receptors may reasonably come into contact with site-related constituents. Exposure pathways are dependent on current and future land use. An exposure pathway is defined by four elements (U.S. EPA, 1989a):

- A source material and mechanism of constituent release to the environment;
- An environmental migration or transport media (e.g., soil) for the released constituents;
- A point of contact with the media of interest; and
- An exposure route (e.g., ingestion) at the point of contact.

An exposure pathway is considered “complete” if all four elements are present. Complete and/or indeterminant pathways will be quantitatively evaluated in the baseline risk assessment. The CSM also identifies pathways that may be complete but for which there currently is not enough information to determine if it is complete or not. Information related to potentially complete and indeterminant exposure pathways will be used to identify data gaps and help guide the data collection effort, ultimately ensuring that data are collected to sufficiently enable risk-based decision making for the Site.

The preliminary CSMs for the Site, as shown in Figures 6 through 9, identify receptors and the potentially complete exposure pathways. On the human health CSM figures (Figures 6 and 7), indeterminant pathways are indicated with a dashed line and check in the potential receptors column and complete pathways are indicated with a bold line and check in the receptor column. On the ecological CSM figures (Figures 8 and 9), potentially complete pathways are indicated by a solid square in the receptors columns. Based on the preliminary CSMs, data needs are identified for the RI and are summarized in Section 3.4. The preliminary CSMs will also be refined as RI data are collected and analyzed, and the refined CSM will be used to develop the exposure assessment portion of the risk assessments.

3.4 DATA NEEDS IDENTIFICATION

A list of site-wide COIs were developed for this RI/FS WP based on site historical information regarding chemicals potentially used or handled at the Site, existing site data, and discussions with EPA during the scoping phase meeting for this Site. As such, COIs for the Site generally include: metals, VOCs, SVOCs, pesticides, and polychlorinated biphenyls (PCBs). As shown in Table 12, the only exceptions include the welding area PSA where COIs are metals and VOCs only, the Electrical Shed PSA where COIs are PCBs only, and the Former Gasoline Storage Tank Area PSA where COIs are VOCs and metals only.

COIs that are carried into the baseline human health risk assessment after the RI will be termed potential chemicals of concern (PCOCs) while COIs that are carried into the ecological risk assessment will be termed chemicals of potential ecological concern (COPECs). Any compounds that pose an unacceptable human health or ecological risk based on the Risk Assessments and are evaluated in the FS will be termed Chemical of Concern (COCs).

Based on an evaluation of the potentially complete pathways identified in Figures 6 through 9, and an analysis of the information needed to assess the completeness of these pathways, the data needs listed in Table 13 were developed. This table illustrates the data needs evaluation process by noting the conceptual model exposure routes that were judged to be indeterminant or complete and potentially significant on Figures 6 through 9, identifying the specific data needs for determining whether that pathway is complete and significant, listing the scoping phase information (e.g., existing data) that were reviewed as part of an initial evaluation, and conceptually describing the RI activities to be performed to fill the identified data need. The conceptual descriptions of RI activities in this table were then used to develop the framework of the RI/FS tasks described in Section 5.0 of this work plan.

4.0 WORK PLAN RATIONALE

This section addresses the data requirements for the human health and ecological risk assessments and the remedial alternatives evaluation, and describes how the proposed remedial investigation will satisfy these data needs.

4.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are based on the proposed end uses of data generated from sampling and analytical activities. DQOs are qualitative and quantitative statements that outline the decision-making process and specify the data required.

DQOs are developed through a seven-step process (EPA, 2000a):

(1) State the problem;
(2) Identify the decision;
(3) Identify the inputs to the decision;
(4) Define the boundaries of the study;
(5) Develop a decision rule;
(6) Specify tolerable limits on decision errors; and
(7) Optimize the design for obtaining data.

As noted in Section 1.0, the overall objective to be addressed by the RI/FS is to evaluate the nature and extent of contamination at and from the Site, assess the risk from this contamination to human health and the environment, and evaluate potential remedial alternatives. More specific problems and subsequent steps in the DQO process vary for each of the indeterminant or complete and potentially significant exposure routes identified in the CSM and used to develop the data needs in Table 13. The seven DQO steps for each of these exposure routes were completed as part of the Quality Assurance Project Plan (QAPP) development process and are addressed on a receptor/media basis in Tables 1 through 5 of the QAPP (PBW, 2005d).

4.2 WORK PLAN APPROACH

The general technical approach for the RI/FS at the Site is based on the following overarching components:

- Use of Existing Data. Given the considerable amount of existing information and consistent with the UAO requirements (SOW Paragraph 26.a), that the RI/FS "consider the use of all existing data and shall justify the need for additional data whenever existing data will meet the same objective", the RI/FS work plan relies heavily on the use of existing data. These existing data are used as the basis for the CSM development and data needs evaluation process described previously.

- Incorporation of the TRIAD Approach. The key elements of the TRIAD approach (EPA, 2003a) are systematic project planning, dynamic work strategies and real-time measurement technologies. These elements are incorporated into the RI/FS whenever possible, with specific uses during the site characterization process noted on Figure 10. Systematic project planning is incorporated into this process through the reliance on existing data (including both operational history information and previous site investigations) and development of the CSM. Dynamic work strategies involve the comparison of data to PSVs as the data are obtained to assess the extent of contamination and the need for additional samples (see Section 5.6). Real-time measurement technologies include the use of surface geophysical methods (see Section 5.6.2) to assess PSAs, and potentially the use of field screening methods for evaluating the presence of non-aqueous phase liquids (NAPL) or field analytical methods.

- Focus on Potential Receptors. Consistent with the identification of COIs associated with specific PSAs and the characterization of those PSAs as needed, the RI/FS focuses on potential receptors and an evaluation of the risks associated with the potential exposure pathways identified in the CSM through a receptor-based investigation program. As the investigation proceeds, the CSM is updated to incorporate the information obtained.

- Consideration of Site End Use Objectives - In addition to the aforementioned goals to characterize the nature and extent of contamination and evaluate potential risks, the RI/FS also considers the desired end use for the Site, both in terms of land use, and potential site development issues, particularly to the extent that the Site remedy supports and may even augment site development plans.

- Recognition of Potential Contributions from Natural Process to Site Remediation – Existing data suggest several natural processes are worthy of consideration as the RI/FS proceeds and potential remedial alternatives are developed.

Specifically, the fine-grained and circumneutral nature of shallow soils in the vicinity is conducive to the attenuation of metals within the vadose zone. Also, given favorable conditions, the chlorinated ethenes (PCE, TCE, cis-1,2-DCE, 1-1-DCE, and vinyl chloride) detected in Site groundwater in the vicinity of the former surface impoundments degrade and attenuate through reductive dehalogenation processes (Wiedemeier et. al., 1998). Coupled with appropriate source controls, these processes may be important components of a final site remedy. As such, the RI/FS includes the collection of data necessary to evaluate natural processes at the Site.

These overarching components of the RI/FS work plan approach have been used as a foundation for the development of the detailed RI/FS work plan tasks described in Section 5.0.

5.0 RI/FS TASKS

As noted in Section 1.0, the objective of the RI/FS WP is to document the decisions and evaluations made during the RI/FS scoping process and present a summary of the work to be performed during the RI/FS. The work plan also presents the initial evaluation of existing Site data and background information, and describes the project management team and schedule. The RI and FS are interactive and will be conducted concurrently, to the extent practicable, in a manner that allows information and data collected during the RI to influence the development of remedial alternatives during the FS. This interactive relationship, will in turn affect additional information and data needs and the scope of any necessary treatability studies and risk assessments.

The following tasks are designed to meet the objectives of the RI/FS.

5.1 TASK 1: PROJECT PLANNING (SCOPING)

The purpose of Task 1 (Project Planning) is to determine how the RI/FS will be managed and controlled. A project scoping meeting is a key part of this task. The scoping phase meeting for the Gulfco Site was held at EPA Region VI offices in Dallas, Texas on August 4, 2005. The topics discussed, documents exchanged and action items taken from that meeting are documented on the meeting notes included in Appendix B. The meeting discussions have been used as the basis for developing this RI/FS WP (Task 2, below).

The other key Task 1 project planning activity is the evaluation of existing information. For this RI/FS WP, the following types and sources of existing Site-related information were evaluated:

- Information describing hazardous substance sources, migration pathways, and potential human and environmental receptors was obtained from reports prepared by previous consultants and the TNRCC, other historical documents in the administrative record compiled by EPA, examination of historical aerial photographs, interviews with personnel familiar with the Site and historical Site operations, and through multiple Site visits. PSAs are identified in Section 3.2 of this work plan. Information regarding potential migration pathways and receptors is described as part of the CSMs in Section 3.3

- Existing data from previous investigations by LTE and TNRCC were tabulated by media (i.e., soil, groundwater, surface water, and sediment) and type of analyte (i.e., metals, VOCs or SVOCs). Previous investigations at the Site are described in Section 2.2.2. The existing data are discussed in Section 3.1.

- Existing information regarding physiography, geology, hydrogeology, hydrology, meteorology, and ecology of the Site was obtained from the literature (e.g., regional publications), TNRCC reports (TNRCC, 2000a and TNRCC, 2002), and selected documents in the EPA administrative file. This information is discussed in Section 2.1.

- Existing data regarding concentration of COIs in background groundwater, background soil, background surface water, and background sediments were obtained from TNRCC reports (TNRCC, 2000a and TNRCC, 2002). This information is included in Tables 2 through 11, as applicable.

- Existing information regarding demographics and land use was obtained from the Site Community Involvement Plan (EPA, 2005a) prepared by EPA. This information is included in Section 2.1.

- Existing data describing residential, municipal, or industrial groundwater wells on and near the Site, and data identifying surface water uses for areas surrounding the Site, were obtained from the literature, TNRCC reports (TNRCC, 2000a and TNRCC, 2002), and selected documents in the EPA administrative file. This information is discussed in Sections 2.1.2.

- Existing information describing the flora and fauna of the Site was obtained from TNRCC reports (TNRCC, 2000a and TNRCC, 2002), selected documents in the EPA administrative file, site visit notes prepared by USFWS personnel (USFWS, 2005), and direct observations during several site visits. Existing data regarding threatened, endangered, or rare species; sensitive environmental areas; or critical habitats on and near the Site were obtained from Texas Parks and Wildlife Department (TPWD, 2005). This information is described in Section 2.1.1 of the work plan.

5.2 TASK 2: REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

The RI/FS WP (this document) is developed in conjunction with the RI/FS Sampling Analysis Plan (SAP) and the Health and Safety Plan (HSP). The following specific elements are included in this RI/FS WP in accordance with the UAO (SOW Paragraphs 21 through 24) and EPA Guidance (EPA, 1988b):

- A comprehensive description of the work to be performed, the methodologies to be utilized, and a corresponding schedule for completion;

- Rationale for performing the required activities;

- A statement of the problem(s) and potential problem(s) posed by the Site and the objectives of the RI/FS;

- A site background summary, which includes the geographic location of the Site, and to the extent possible, a description of the Site's physiography, hydrology, geology, and demographics; the Site's ecological, cultural, and natural resource features; a synopsis of the Site history and a description of previous responses that have been conducted at the Site by local, state, federal, or private parties;

- A summary of the existing data in terms of physical and chemical characteristics of the contaminants identified, and their distribution among the environmental media at the Site;

- A description of the site management strategy developed during scoping;

- A preliminary CSM; and

- A detailed description of the tasks to be performed, information needed for each task and for the Baseline Risk Assessment, information to be produced during and at the conclusion of each task, and a description of the work products and deliverables to be submitted to the EPA.

5.3 TASK 3: REMEDIAL INVESTIGATION/FEASIBILITY STUDY SAMPLING AND ANALYSIS PLAN

The RI/FS SAP provides a mechanism for planning field activities. The SAP consists of the following:

- Volume I – the RI/FS Field Sampling Plan (FSP) defines in detail the sampling and data gathering methods that will be used for the project. It includes discussions of sampling objectives, sample rationale, locations and frequency, sampling equipment and procedures (including standard operating procedures or SOPs), and sample handling and analysis.

- Volume II – the Quality Assurance Project Plan (QAPP) describes the project objectives and organization, functional activities, and quality assurance and quality control (QA/QC) protocols that will be used to achieve the desired DQOs. The RI/FS QAPP also addresses sampling procedures, sample custody, analytical procedures, data reduction, data validation, data reporting, and personnel qualifications.

The RI/FS SAP, including the FSP and QAPP, addressing the above requirements is submitted to EPA concurrent with this RI/FS WP. The FSP and QAPP provide for the addition of plan addenda as the need for additional field sampling or quality assurance procedures are identified during the course of the RI/FS.

5.4 TASK 4: REMEDIAL INVESTIGATION/FEASIBILITY STUDY HEALTH AND SAFETY PLAN

An RI/FS Site HSP must be in place prior to any on-site activities. The HSP describes the safety and health protocols for PBW personnel and subcontractors during RI/FS field activities. The plan assigns personnel responsibilities, prescribes mandatory safety procedures, and establishes personal protective equipment requirements for the various field investigation tasks. The HSP provides for the addition of plan addenda as additional sampling or health and safety activities are identified during the course of the RI/FS. The HSP (PBW, 2005a) addressing the above items and pertinent Occupational Safety and Health Administration (OSHA) and EPA requirements was submitted to EPA on August 18, 2005. This plan will be reviewed, but not approved by EPA. To date, no review comments on the HSP have been received from EPA.

5.5 TASK 5: COMMUNITY RELATIONS PLAN

The development and implementation of community relations activities, including conducting community interviews and developing a community relations plan, are the responsibilities of EPA. EPA distributed the Community Involvement Plan (CIP) (EPA, 2005a) at the project scoping meeting. As indicated therein, EPA will revise the CIP as community concern warrants or at least every three years until the Site is closed. The extent of the Respondents' involvement in community relations activities will be determined by EPA.

5.6 TASK 6: SITE CHARACTERIZATION

This task involves the implementation of the RI/FS WP as detailed in the SAP, including the FSP and QAPP, in accordance with the HSP. The overall objective of the Site characterization effort is to identify areas of the Site that may pose a threat to human health or the environment. This objective is accomplished by obtaining information necessary to address those data needs associated with potentially complete or indeterminant exposure pathways as described in the CSM, and identified during the project planning process (Task 1) (listed in Table 13). The deliverables for this task consist of the Preliminary Site Characterization Report (Subtask 6.9) and the RI Report (Task 9). As noted in the UAO, Site characterization activities are often iterative, and to satisfy the objectives of the RI/FS it may be necessary to supplement the specific activities outlined herein. Figure 10 provides a flow chart outlining the Site characterization process performed as part of this task.

The specific subtasks outlined below involve coordination of field investigation and data analyses activities. In some cases these activities may be performed in measured, sequential fashion. In other instances, they may be performed on a dynamic, real-time basis, consistent with the TRIAD approach as noted in Section 4.2. Please note that the following task/subtask descriptions are a summary of the detailed field and laboratory procedures in the SAP.

For each media to be evaluated at the Site, a list of PSVs was established. The sources of the PSVs for each media and how they were derived are discussed in the following sections. PSVs will be generally used to evaluate the nature and extent of a COI; however, COI concentrations that exceed PSVs are not necessarily indicative of adverse human health or ecological effects.

The characterization subtasks described below are focused on environmental media. As described in Section 2.2.2, previous investigations by LTE (LTE, 1999) evaluated the volume and waste characteristics of residual materials in ASTs and drums at the Site, to the point of identifying specific waste streams, waste codes, and recommended management options. Although it is recognized that there may have been some changes in waste volumes and characteristics since these data were collected, the data are considered adequate for the purpose of developing and evaluating remedial action alternatives in the FS and additional sampling of these materials during the RI is not proposed. Given that any off-site waste management facility will require data collected within a relatively short time (often 30 to 90 days) prior to shipment, additional sampling of these materials will be performed prior to removal in consideration of the specific data requirements of the off-site waste management facilities to be used.

5.6.1 Subtask 6.1: Former Impoundment Cap Evaluation

The purpose of this subtask is to assess the construction materials and thickness of the caps constructed on the former surface impoundments to evaluate the potential for transport of VOCs from any residual waste materials through the cap/cover material to air. The following activities shall be performed as part of this subtask:

a. Advance four soil borings within the former surface impoundments. Borings will be drilled and continuously sampled to a depth of five (5) feet or to the base of the cap material, whichever occurs first.

b. Collect one representative soil sample from each boring for laboratory geotechnical analyses (Percent Passing No. 200 Sieve, Atterburg Limits, and vertical hydraulic conductivity).

c. Perform a field inspection of the caps, including observation of desiccation cracks, erosion features, and overall surface condition.

d. Using cap geotechnical properties and field inspection observations, qualitatively evaluate the caps integrity, and the potential for organic vapor transport through the caps.

5.6.2 Subtask 6.2: Surface Geophysics Evaluation

The objective of this subtask is to attempt to locate former pipelines at the Site that may have been used to transport product material or wash water associated with the barge cleaning process from the barges and former AST tank farm to the former surface impoundments or the wash water storage tank area. As indicated on Figure 10, this subtask represents a real-time measurement technology consistent with the TRIAD approach, and data obtained from this subtask will be used to select sample locations in subsequent Subtasks 6.3 and 6.5.

An electromagnetic (EM) metal detector (Geonics EM-61 or equivalent) and an EM radiodetection (RD) meter will be used to record magnetic anomalies caused by buried metal. This data will be used to identify potential pipelines at the Site and to adjust the proposed soil sampling locations along the potential pipelines between the former AST tank farm area and the former surface impoundments or the former wash water storage tank area.

5.6.3 Subtask 6.3: Soil Investigation

The purpose of this subtask is to evaluate the lateral and vertical extent of COIs in soils to evaluate potential human health and ecological risks associated with direct contact with and ingestion of soil, or potential runoff from these areas to surface water.

The following activities shall be performed as part of this subtask:

a. Soil samples will be collected from the judgmental and grid-based locations associated with each of the PSAs shown on Figure 5. As detailed in the FSP, judgment-based sample locations within the PSAs will be selected based on field observations (e.g., an observed seep area below the former AST tank farm containment wall), existing data, or the locations within the PSA where the potential for a release may be more likely (e.g., near the sump within the AST tank farm). The projected number of initial soil samples within each PSA is listed in Table 14. Specific sample locations are detailed in the FSP. At each sample location, samples will be collected from the 0 to 6 inch and 12 to 24 inch depth intervals. The analyte list for each sample will correspond to the COI list for its PSA as listed in Table 12, except that VOC analyses will not be performed on samples from the 0 to 6 inch depth interval.

b. In addition to the PSA-based samples, grid-based soil samples will be collected on a 100-foot grid spacing (random location selected within each grid) in the South Area and a 200-foot grid spacing in the North Area for any grid blocks not already sampled as part of the PSA sampling program. Soil samples will not be collected from grid-based locations falling within the wetland areas shown on Figure 3 (or obviously observed to be wetland areas during sampling); rather sediment samples will be collected from these locations as described in Task 6.7. At each grid-based location, samples will be collected from the 0 to 6 inch and 12 to 24 inch depth intervals. These samples will be analyzed for the Former AST Tank Farm COI list indicated in Table 12, except that VOC analyses will not be performed on samples from the 0 to 6 inch depth interval.

c. A third set of surface soil samples will be collected from the Lot 21 area of the Site (Figure 5). This lot was primarily associated with former dry dock and sand blasting operations. These samples will be collected from the 0 to 1 inch interval from biased locations near the sand blasting locations and along the former dust control screen along the western boundary of Lot 21 and from random locations within a 100-foot sample block grid. Consistent with the historical uses of this area, these surface soil samples will be analyzed for the “Lot 21” COI list on Table 12 (metals only).

d. Samples will be collected using either a hand auger, a plastic or stainless steel trowel, or a split-spoon sampler advanced by a drill rig. Sample collection and handling procedures, including sampling decontamination methods are specified in the FSP.

e. As indicated on Figure 10, field analytical methods may be used in lieu of laboratory analyses for the grid-based sample locations, provided that the field method has satisfied all Demonstration of Method Applicability (DMA) requirements as approved by EPA, and at least 10% of the total number of samples proposed for the field analysis are also analyzed using the laboratory methods identified in QAPP.

f. In addition to the COI analyses described above, three representative soil samples from the North Area and three representative soil samples from the South Area (to be selected based on field observations) will be analyzed for bulk density, specific gravity, total organic carbon (toc) and pH to support evaluations of soil attenuation processes.

g. As shown on Figure 10, once analytical data have been determined to be useable in accordance with the data validation procedures specified in the QAPP, the soil sample analytical results will be compared to the PSVs listed in Table 15 for North Area soils and Table 16 for South Area soils, to assist with defining the nature and extent of contamination.
COI concentrations in soil samples from the North Area will be compared to PSVs, which will be the lower of the human health and ecological screening levels. The human health screening levels are EPA Region 6 Media-Specific Soil Screening Criteria (SSC) (EPA, 2005b) for outdoor industrial workers and, if a value is not available for a compound, the lower of the TCEQ $^{GW}Soil_{Class3}$ Protective Concentration Level (PCL) and $^{Tot}Soil_{Comb}$ PCL for commercial/industrial land use. The ecological screening levels are EPA Ecological Soil Screening Levels (SSLs) (EPA, 2003b) and, if a value is not available for a compound, TCEQ Ecological soil benchmarks (TNRCC, 2001) will be used. PSVs for soil samples collected from the South Area will be the human health screening levels described above. Ecological screening levels will not be used for the South Area per previous EPA technical discussions and because the industrial nature of the property does not provide suitable habitat. COI concentrations in the 0 to 1 inch depth interval samples from Lot 21 will be compared to the human health PSVs for residential land use (i.e., EPA Region 6 SSC and if unavailable, the lower of the TCEQ $^{GW}Soil_{Class3}$ PCL and $^{Tot}Soil_{Comb}$ PCL).

These PSV comparisons are subject to adjustment based on background concentrations (i.e., values below background will not be considered exceedences). Background concentrations were identified based on previous background samples collected in the site vicinity, background samples collected as part of this investigation (see below), Texas-specific background concentrations identified in 30 TAC 350.51(m), or other appropriate literature background values approved by EPA.

h. Depending on the specific COIs and concentrations detected, background soil sampling may be performed as part of this subtask. If such sampling is performed, six (6) background soil samples will be collected from each of two locations northeast and northwest of the Site as shown in Figure 4 of TNRCC, 2002. Background soil samples will be collected using the same methods as used to collect the Site soil samples. The analytical suite for any background samples will be developed following completion of initial Site soil sampling and analytical activities.

i. As shown on Figure 10, should a grid location at the perimeter of the Site exceed a PSV, then a minimum of two additional grids with maximum dimensions of 200 feet (or 100 feet for samples collected on a 100-ft grid basis) will be created outside of the exceeding grid, and these new grid areas will be sampled at one random location within each grid and analyzed in the same fashion as the soil samples in this task. These samples will be analyzed for those COIs exceeding their respective PSVs in the adjacent samples. If additional delineation is needed on off-site properties, access for those properties will be obtained at the time the properties are identified in accordance with UAO requirements.

j. Should any COIs in the Lot 21 samples collected from 0 to 1-inch depth interval exceed its residential PSV on a statistical basis, then a program for sampling surface soils on the adjacent property to the west will be developed. This program will be limited to the specific COIs detected above their respective residential PSVs in the Lot 21 surface samples.

5.6.4 <u>Subtask 6.4: Water Well Survey</u>

The purpose of this subtask is to provide supporting information for evaluating the potential for COI-containing groundwater or NAPL migration to water supply wells.

The following activities shall be performed as part of this subtask:

a. An updated search of Texas Water Development Board (TWDB) and TCEQ records for registered water wells located within ½-mile radius of the Site boundary will be performed. As part of this search, information related to water well completion, lithology, owner, status, use, and water quality (if available) will be compiled.

b. A field survey to confirm/update information obtained during the records search will be performed and attempts will be made to identify any unregistered water supply wells located within ½-mile radius of the Site boundary. If any unregistered wells are identified, available information related to water well completion, lithology, owner, status, use, and water quality will be collected.

5.6.5 Subtask 6.5: Groundwater/NAPL Investigation

The purpose of this subtask is to evaluate the lateral and vertical extent of potential NAPL and COIs in groundwater in order to evaluate potential human health and ecological risks associated with: (1) groundwater or NAPL migration to water supply wells; (2) groundwater or NAPL migration to surface water; (3) potential volatilization of VOCs from groundwater to ambient air; and (4) potential vapor migration to indoor air in residential areas.

The following activities shall be performed as part of this subtask:

a. As shown on Figure 10, initial NAPL/groundwater investigation activities will involve the installation and development of permanent groundwater monitoring wells in the vicinity of Site PSAs as follows:

- Former AST Tank Farm Area – three locations;
- Pipelines – one location along path of pipeline from former AST Tank Farm Area to former surface impoundments, and one location between the former AST Tank Farm and the Intracoastal Waterway;
- Former Surface Impoundment Area – four locations on impoundment perimeter;
- Former Wash Water Storage Tank Area – one location;
- Sand Blast Areas – one location at each of the two sand blast areas;
- Welding Area – one location;
- Surface Drainage Areas – one location;
- Former Septic Tank Areas – one location at each of the two former septic tank areas; and
- Former Product Storage Tank Area – one location.

These 17 PSA-based wells include four locations immediately northwest of the Intracoastal Waterway and two near the Site barge slips that will provide an indication of groundwater conditions near likely points of discharge to surface water. Pending resolution of access and wetlands-related issues, groundwater samples will be collected from two direct push or temporary monitoring well locations in the area southwest of the Former Surface Impoundment Area. Specific groundwater sample locations are proposed in the FSP, and as described therein, sample locations may be modified in the field based on accessibility constraints or field observations.

b. Soil borings for monitoring wells will be advanced using hollow stem auger methods. Soil samples will be collected continuously from each. Soil samples will be logged in the field for lithology and sedimentary structure. Soil headspace samples will be periodically collected and analyzed in the field for total organic vapor concentrations and soil core samples will be visually inspected for NAPL presence and field screening. Soil borings will be advanced as necessary to identify the top and base of the uppermost water bearing-unit at the Site. Based on the boring logs for previous monitoring wells drilled at the Site, it is anticipated that these borings will be advanced to a maximum depth of 30 feet. In no case will a boring in which field indications of a dense NAPL (DNAPL) are noted be advanced through an underlying low permeability confining unit. PVC monitoring wells will be constructed within each soil boring as the augers are withdrawn. Soil boring drilling and sampling procedures, and monitoring well construction and development procedures are specified in the FSP.

c. Staff gauges will be installed at the Intracoastal Waterway shoreline and within the wetlands north of the Site. Monitoring wells and staff gauges will be surveyed relative to mean sea level to allow comparison of water level elevations.

d. After a sufficient recovery time following well development, a complete set of water levels (including an evaluation of the possible presence of NAPL using an interface probe, conductivity probe and bailer) will be measured in all wells. Groundwater samples will be collected using a peristaltic or bladder pump in accordance with low-flow sampling procedures detailed in the FSP. The analyte list for each groundwater sample will correspond to the COI list for its PSA as listed in Table 12. The perimeter groundwater samples will be analyzed for the Former AST Tank Farm COI list. In addition, one groundwater sample from the North Area and one groundwater sample from the South Area will be analyzed for total dissolved solids, major anions and major cations.

e. As indicated in Figure 10, if the presence of NAPL is identified in any of the monitoring wells, the following actions will be taken:

- Attempts will be made to collect a sample of the NAPL from each well in which it is observed. NAPL samples will be analyzed for specific gravity, VOCs, SVOCs and pesticides.

- The use of possible field screening methods to evaluate NAPL presence will be evaluated. If a promising candidate method is identified, a pilot test of the method will be performed, and depending on the pilot test results, a DMA will be prepared and submitted to EPA for review and approval.

- The lateral extent of NAPL will be defined in the affected water-bearing unit. A combination of direct push methods, auger drilled soil borings, and/or monitoring wells may be used in this effort. The lateral extent of NAPL will be defined by the absence of any field screening indications in a boring or direct push location, or the absence of detectable NAPL in a well. Any NAPL field screening techniques used in this effort will be subject to DMA requirements and EPA approval described above.

- The vertical extent of DNAPL will be defined by advancing deeper borings (using direct push or auger methods) or installing deeper monitoring wells outside the perimeter of the identified DNAPL zone to the base of the next underlying water-bearing unit, or within the DNAPL zone if a surface isolation casing used and a competent underlying confining unit is identified. The vertical extent of DNAPL will be defined by the absence of any field screening indications in a boring or direct push location, or the absence of detectable DNAPL in a well.

f. As shown on Figure 10, once analytical data have been determined to be useable in accordance with the data validation procedures specified in the QAPP, the groundwater sample analytical results will be compared to the PSVs listed in Table 17 for the purposes of assessing whether the lateral and vertical extent of COIs has been identified. It should be noted that the PSVs are used to generally provide an indication of potential release and are not indicative of adverse health or ecological effects. Groundwater PSVs will be defined as the lowest of the following: $^{GW}GW_{Class3}$ PCL, $^{Air}GW_{Inh\text{-}V}$ PCL, and TCEQ Ecological Benchmarks for water (TCEQ, 2001 and updates). These PSVs will be based on commercial/industrial land use assumptions. PSV comparisons are subject to adjustment based on background concentrations (i.e., values below background will not be considered exceedences) with background concentrations identified based on previous background samples collected in the Site vicinity, background samples collected as part of this investigation, or other appropriate literature background values approved by EPA.

g. Should any groundwater sample location at the perimeter of the Site exceed a PSV, then a minimum of two additional groundwater samples will be collected outside of the location exceeding the PSV in the same water-bearing zone. These additional groundwater samples will be collected in the same fashion as the groundwater samples in this subtask and will be analyzed for those COIs exceeding their respective PSVs at the perimeter location. This collection of additional samples will be repeated until the extent of ground water contamination has been delineated to PSVs. The contingent groundwater samples will be analyzed for those COIs exceeding their respective PSVs in the samples.

h. In response to EPA requests, the subsurface stratigraphy from the ground surface to the top of the uppermost water supply aquifer will be evaluated through advancement of a mud rotary pilot boring to an approximate depth of 200 feet. The location will be selected following delineation of the lateral extent of COIs exceeding PSVs in order to ensure the boring is not drilled in an area where Site contaminants could potentially migrate to deeper water-bearing units as a result of drilling activities. The pilot boring will be geophysically logged for the following geophysical logging signatures: Spontaneous Potential (SP); resistivity (single point, short and long normal); and natural gamma. The geophysical log signatures will be compared to the drill cuttings to correlate the lithology to the geophysical signatures. Drilling and borehole logging procedures to be used for this boring are described in the FSP.

i. In order to evaluate groundwater flow rates and directions, Site water level data will be used to construct potentiometric surface maps for the Site. In addition, hydraulic testing will be performed on up to three monitoring wells to evaluate the hydraulic conductivity of the water-bearing unit(s). Wells for hydraulic testing will be selected based on lithologic data, water level measurements, and drawdown/recharge behavior encountered during development and sampling, with the goal of selecting wells that represent the range of hydraulic conditions in the uppermost water-bearing unit at the Site. Hydraulic testing and associated data analysis procedures are detailed in the FSP.

5.6.6 Subtask 6.6: Surface Water Investigation

The purpose of this subtask is to evaluate the lateral extent of potential COIs in surface water in the wetlands north of Marlin Avenue and in ponds on the Site. The surface water data will be used to evaluate potential human health and ecological risks associated with direct contact with and/or ingestion of surface water by human or ecological receptors.

The following activities shall be performed as part of this subtask:

a. Surface water samples will be collected from 15 locations within the wetlands north of Marlin Avenue (including both on-site and off-site locations). These sample locations will be determined at the time of sampling based on drainage features and field observations. In addition three surface water samples will be collected from each of the two ponds on or adjacent to Lot 55.

b. Surface water samples will be collected using a bailer, dip sampler or other discrete depth sampling equipment from the water surface. Filtered and unfiltered samples will be collected for metals analyses. Field pH will be measured at the time of sample collection. Sample collection and handling procedures, including sampling decontamination methods are specified in the FSP.

c. Surface water samples will be analyzed for VOCs, SVOCs, metals, pesticides, PCBs, and hardness, as detailed in the FSP.

d. Once analytical data have been determined to be useable in accordance with the data validation procedures specified in the QAPP, the surface water sample analytical results will be compared to the applicable PSVs as listed in Table 18 for the purposes of evaluation lateral extent of COIs in surface water.

COI concentrations in surface water samples will be compared to PSVs defined as the lowest of the following: Texas Surface Water Quality Standards, $^{Tot}SW_{Comb}$ PCL, and TCEQ Ecological Benchmarks for water (TCEQ, 2001 and updates). These PSV comparisons are subject to adjustment based on background concentrations (i.e., values below background would not be considered exceedences) with background concentrations identified based on background samples collected as part of this investigation, or other appropriate literature background values approved by EPA.

e. Should any surface water sample location at the perimeter of the wetland area exceed a PSV, then a minimum of two additional surface water samples will be collected within 200 feet of the location exceeding the PSV. The collection of additional surface water samples will be repeated until the extent of surface water COIs above their respective PSVs have been delineated. The additional surface water samples will be analyzed for those COIs exceeding their respective PSVs in the adjacent samples.

5.6.7 Subtask 6.7: Sediment Investigation

The purpose of this subtask is to evaluate the lateral extent of COIs in sediments in order to evaluate potential human health and ecological risks associated with: (1) uptake of COIs from sediments by ecological receptors and subsequent ingestion; and (2) direct contact with and/or ingestion of sediments.

The following activities shall be performed as part of this subtask:

a. Within wetland areas in the North Area (as shown on Figure 3 or determined by field observations), sediment samples will be collected on a 200-foot grid (random location selected within each grid). In addition, sediment samples will be collected from 15 off-site locations within the wetlands north and east of the Site. These sample locations will be identified at the time of sampling based on drainage features and field observations. Sediment samples from the wetland areas will be collected using a stainless steel scoop or grap (Ekman) sampler as detailed in the FSP. Samples will be collected from the from the 0 to 6 inch depth interval and will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, grain-size, and total organic carbon as described in the FSP.

b. Sediment samples will be collected from five locations within the Fresh Water Pond on Lot 55 of the Site and three sediment samples will be collected from the smaller pond to the southeast. These sediment samples will be collected from a boat using a piston corer or stainless steel grab (Ekman) sampler as detailed in the FSP. Again, samples will be collected from the from the 0 to 6 inch depth interval and will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, grain-size, and total organic carbon.

c. Sediment samples will be collected from the Barge Slips and Intracoastal Waterway as follows:

- Barge Slip 1 – five locations;
- Barge Slip 2 – five locations;
- Intracoastal Waterway – six locations; and
- Background – nine locations.

Specific sample locations are shown in the FSP. Locations adjacent to the Site are intended to correspond to former pipeline locations or Site runoff features (drainage areas). The background location will be located on the south side of the Intracoastal Waterway approximately 1.5 miles northeast of the Site**.** Samples for laboratory analysis will be collected from the 0 to 6 inch depth interval and will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, grain-size, and total organic carbon.

d. As shown on Figure 10, once analytical data have been determined to be useable in accordance with the data validation procedures specified in the QAPP, the sediment sample analytical results will be compared to the applicable PSVs listed in Table 19 to evaluate the lateral extent of COIs.

COI concentrations in sediment samples will be compared to the PSVs, which will be the lower of the human health and ecological screening levels for sediment. The human health sediment screening levels will be based on $^{Tot}Sed_{Comb}$ PCLs while the ecological screening levels will be based on TCEQ Ecological Benchmarks for sediment (TCEQ, 2001 and updates). If there is not a TCEQ Ecological Benchmark available, EPA EcoTox Threshold criteria (EPA, 1996) will be used. These PSV comparisons are subject to adjustment based on background concentrations (i.e., values below background would not be considered exceedences) with background concentrations identified based on previous background samples collected in the site vicinity, background samples collected as part of this investigation, or other appropriate literature background values approved by EPA.

e. Should any sediment sample location at the perimeter of the sampled area (except for the background area) exceed a PSV, then a minimum of two additional sediment samples will be collected within 200 feet of the location exceeding the PSV. This collection of additional sediment samples will be repeated until the extent of COIs in sediment exceeding their respective PSVs has been delineated to PSVs. These samples will be analyzed for those COIs exceeding their respective PSVs.

5.6.8 Subtask 6.8: Fish Tissue Investigation

Because of public concerns related to the safety of the consumption of fish and shellfish in the area of the Site, EPA requested that the RI/FS include a fish and crab sampling investigation. During previous technical discussions, EPA suggested sampling three fish of three different finfish species and three blue crab samples; however, in order to provide a more statistically robust dataset, nine tissue samples each of three different finfish species and nine blue crab tissue samples will be collected to assess the human health fish ingestion pathway. Species to be sampled for this investigation are red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*), southern flounder (*Paralichthys lethostigma*), and blue crabs (*Callinectes sapidus*). These species were selected because they are commonly found in the Intracoastal Waterway near the Site and they are harvested by commercial and recreational fishermen for human consumption. Sampling will be conducted during Autumn since this is the time when the target species are most likely to be present in the Site vicinity. Legal-sized fish and crab will be collected for analysis to correspond to the size of fish consumed by the public.

As part of this subtask, background fish tissue samples will also be collected at the same time as the Site fish tissue samples. The background sampling area will correspond to the background sediment sample location described in Subtask 6.7. Nine legal size fish and crab of the same four target species will be collected from the background area and archived for possible analysis pending analysis of the Site fish tissue samples. Sample collection, handling and archiving procedures are provided in the FSP (PBW, 2005c) and are based on EPA guidance (EPA, 1989b and 2000b).

COIs for fish tissue will be determined based on Site sediment data collected for Subtask 6.7 since sediments are the primary source of chemicals that may be available for uptake into fish. Specifically, fish and crab samples will be analyzed for those compounds detected in Site sediment samples above the sample quantitation limit (SQL) (i.e., J-flagged data reported below the SQL will not be considered) and above background sediment concentrations. The sediment background comparison for this evaluation will be based on the background samples collected for Subtask 6.7 using a means comparison.

This sediment background comparison is necessary to ensure that compounds measured in fish and crab are related to the Site because of the mobility of finfish and crab and the potential for other sources to contribute to the organisms' body burden. Based on discussion with EPA, essential nutrients such as calcium, iron, phosphorus, potassium and sodium will not be analyzed for in fish and crab samples. Magnesium is also considered an essential nutrient per EPA guidance (EPA, 1989a) and, as such, will also not be analyzed for in fish and crab samples.

Fish and crab data will be included in the RI report (since these data are collected for risk assessment and not site characterization purposes, they will not be included in the Preliminary Site Characterization Report (PSCR)). The data will be evaluated in the Baseline Human Health Risk Assessment (BHHRA) to determine if this pathway is complete and if it potentially poses an adverse risk. Data evaluation procedures are described in Section 5.7.1.

5.6.9 Subtask 6.9: Preliminary Site Characterization Report

As the initial deliverable to be submitted following completion of the site characterization subtasks, the PSCR describes the investigative activities that have taken place, and provides Site data documenting the location and characteristics of surface and subsurface features and contamination at the Site including the affected medium, location, types, physical state, and concentration and quantity of contaminants. In addition, the location, dimensions, physical condition, and varying concentrations of each contaminant throughout each source, and the extent of contaminant migration through each of the affected media is documented. The PSCR is intended to function as a preliminary reference for developing the Baseline Human Health and Ecological Risk Assessments, evaluating the development and screening of remedial alternatives, and the refinement and identification of applicable or relevant and appropriate requirements (ARARs) in subsequent RI/FS tasks.

The Draft PSCR will be submitted to EPA for review and approval within thirty (30) calendar days following receipt and validation of all sample analytical results from the laboratory. The Final PSCR will be within twenty (20) calendar days from the receipt of the EPA's comments on the draft report.

5.7 TASK 7: RISK ASSESSMENT

A BHHRA and other human health deliverables as described in the UAO, such as the exposure assessment memorandum, a SLERA, and a Baseline Ecological Risk Assessment (BERA) (if necessary) will be prepared for the Site. The Human Health and Ecological Risk Assessment Processes and the activities to be performed as part of each are generally described below.

The Sampling and Analysis Plan, which consists of the QAPP and Field Sampling Plan, was designed to ensure that the data collected during the RI are appropriate for quantitative risk assessment. After RI data collection, the RI data will be subject to validation using procedures specified in the QAPP to ensure that these data are of adequate quality for quantitative risk assessment and to support risk management decisions. Data selected for use in the quantitative risk assessment will be of overall high quality.

5.7.1 <u>Human Health Risk Assessment</u>

A BHHRA will be conducted for the Site. The objective of the BHHRA is to evaluate the potential impacts of chemicals in environmental media on human receptors so that risk management is the basis of remedial decisions. Thus, the results of the BHHRA will be used to determine whether or not remedial action is necessary and the justification for performing any remedial actions.

The risk assessment process described herein uses the methodology that the Superfund Program has established for characterizing the nature and extent of potential risks posed by uncontrolled hazardous waste sites and for developing and evaluating remedial options. Because it is a risk-based process, risk assessment data needs are considered throughout the RI/FS, from work plan development and project scoping to designing and implementing remedial actions identified in the FS. The risk assessment methodology that will be used is based on the risk-based approaches described by the U.S. EPA in Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual, Part A (EPA, 1989a) and various supplemental and associated guidance documents. The risk assessment process is generally composed of four components:

- Contaminant identification;
- Exposure assessment;
- Toxicity assessment; and
- Risk characterization.

Contaminant Identification

In order to focus subsequent efforts in the risk assessment process, the RI analytical data will be reviewed and PCOCs identified based on the screening processes described in RAGS (EPA 1989a).

A Draft PCOC Memorandum will be submitted to EPA no later than 20 calendar days following receipt of EPA approval of the Final PSCR. A Final PCOC Memorandum will be submitted to EPA within seven days from the receipt of the EPA's comments on the draft memorandum.

Toxicity Assessment

The toxicity assessment will consider the types of adverse health or environmental effects associated with individual or multiple exposures, the relationship between magnitude of exposures and adverse effects, and related uncertainties, such as the weight of evidence for a chemical's potential adverse effect. Toxicity and dose-response information will be used to generate both qualitative and quantitative estimates of risk associated with the PCOCs.

Exposure Assessment

The objectives of the exposure assessment are to more fully characterize potential exposure pathways, to characterize potentially exposed populations or ecological resources, and to determine the levels of potential exposure. Preliminary CSMs described in Section 3.2 provide information related to potentially complete exposure pathways. This section of the risk assessment will further evaluate the CSM in context of the RI data and the BHHRA. The source characteristics and release mechanisms for each contaminant will be identified on the basis of the existing data and data generated during the RI/FS. The potential environmental transport and transfer mechanisms will be evaluated to assess migration pathways. The next step will be to identify potential exposure points for identified receptors and describe potential uptake mechanisms once a receptor comes into contact with a contaminant in a specific environmental medium.

Once the exposure pathways are understood, the potential for exposure will be assessed. Identification of current and potential land uses in the area where exposure may occur is critical to this assessment. Maximum exposure scenarios will be developed, which reflect the nature of the exposures that could occur based on the expected use of the area. A Draft Exposure Assessment Memorandum (EAM) will be submitted to EPA no later than 30 days following receipt of EPA approval of the Final PSCR.

Risk Characterization

The potential risks of adverse health or environmental effects for each of the scenarios described in the exposure assessment will be characterized. The estimates of risk will be obtained by integrating information developed during the toxicity and exposure assessments to characterize the potential or actual risks (carcinogenic, noncarcinogenic and environmental). The risk associated with each potential exposure route for PCOCs will be described. Weight-of-evidence issues associated with toxicity data and other uncertainties related to the exposure assessment will be discussed.

Fish tissue data collected during Subtask 6.8 will be evaluated as part of the risk characterization process. Specifically, 95 percent upper confidence limits on the arithmetic mean (95% UCLs) will be estimated for each chemical measured in fish and crab samples, for each species of fish, and this value will be used as the exposure point concentration in the risk assessment. If the fish tissue data evaluation shows that the 95% UCL is below its associated risk level for each constituent, it will be concluded the Site does not pose an unacceptable risk for this pathway and the fish are safe to eat.

If estimated risks, based on the fish tissue sampling, exceed EPA's target risk range of 1 in 1,000,000 to 1 in 10,000 or a hazard quotient of 1, background fish samples will be analyzed for those constituents posing an unacceptable risk. An appropriate statistical test comparing means will be performed to determine if fish concentrations from the Site are the same as background fish or not. This will provide information related to the Site's impact on the fish population.

As another line of evidence to determine whether the Site is adversely impacting fish, fate and transport calculations as per EPA guidance (EPA, 1998) will be conducted using literature-derived biota-sediment accumulation factors (BSAFs) to estimate fish tissue concentration from a given sediment concentration. This calculation is most appropriate for hydrophobic compounds, which tend to bioaccumulate, and is generally represented by the following equation:

$$C_{fish} = \frac{C_{sb} \times f_{lipid} \times BSAF}{foc_{sed}}$$

where:

C_{fish} = Concentration of PCOC in fish tissue (mg PCOC/kg FW tissue)

C_{sb} = Concentration of PCOC sorbed to bed sediment (mg PCOC/kg be sediment)

f_{lipid} = Fish lipid content (unitless)

BSAF = Biota-to-sediment accumulation factor (unitless)

foc_{sed} = Fraction of organic carbon in bottom sediment (unitless)

Standard default values are available for fish lipid content and fraction of organic carbon (foc) in bottom sediment, although site-specific measurements are useful and reduce uncertainty. Foc data will be collected as part of sediment sampling activities. If needed to refine these calculations, fish lipid content data may be obtained from the archived fish tissue samples. The estimated fish tissue concentrations will be compared with fish tissue analytical results to assess the likelihood that any concentrations found in fish tissue are associated with Site conditions

A Draft BHHRA Report will be submitted to EPA no later than 30 days following receipt of EPA approval of the Final EAM. A BHHRA will be submitted within 20 days of receipt of the EPA's comments on the draft report.

5.7.2 Ecological Risk Assessment

The SOW for the RI/FS at the Site, provided as an Attachment to the UAO from the EPA, requires an Ecological Risk Assessment (ERA). The SOW specifies the Respondents to follow EPA's Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA, 1997). This guidance document proposes an eight-step approach for conducting a scientifically defensible ERA:

1. Screening-Level Problem Formulation and Ecological Effects Evaluation;
2. Screening-Level Preliminary Exposure Estimate and Risk Calculation;
3. Baseline Risk Assessment Problem Formulation;
4. Study Design and Data Quality Objectives;

5. Field Verification of Sampling Design;
6. Site Investigation and Analysis of Exposure and Effects;
7. Risk Characterization; and
8. Risk Management.

Briefly, Steps 1 and 2 of the process are scoping phases of the ERA in which existing information is reviewed to preliminarily identify the ecological components that are potentially at risk, the COPECs, and the transport and exposure pathways that are important to the ERA. This process is conducted using conservative assumptions to avoid underestimating risk or omitting receptors or COPECs, and constitutes the SLERA. Steps 3 through 8 are conducted in a sequential fashion based on the results and conclusions of the previous step. Step 3 uses the results of the SLERA to identify methods for risk analysis and characterization. Steps 4 through 7 include formalization of the data needs, data collection, and data analysis for the risk characterization and typically comprise the BERA. Risk management activities are the eighth step in the process.

Steps 1 and 2 were completed with the submittal of the draft SLERA to EPA on August 29, 2005 (to date, no comments have been received on the Draft SLERA). The SLERA concluded with a scientific management decision point (SMDP), which indicates if additional ecological evaluation is necessary. Based on the SLERA, additional data are recommended to better characterize the nature and extent of contamination and potential risks associated with the Site. Identification of COPECs for the BERA was one of the primary objectives of the SLERA and was based primarily on exceedences of risk-based criteria by maximum soil and sediment concentrations. The COPECs proposed for inclusion in the updated SLERA (to be performed after completion of additional soil and sediment data during the RI) and possibly the BERA are:

- Terrestrial Habitats (soil)
  - Barium (due to potential migration from the south parcel of the Site);
  - Chromium;
  - Cobalt;
  - Lead;
  - Manganese;
  - Zinc;
  - Polyaromatic Hydrocarbons (PAHs); and
  - Pesticides

- Estuarine Wetland and Aquatic Habitats (sediment)
  - Arsenic;
  - Barium;
  - Zinc;
  - PAHs;
  - PCBs; and
  - Pesticides.

Additional soil data, however, are not necessary for ecological risk purposes for the following compounds: aluminum, antimony, arsenic, beryllium, cadmium, calcium, copper, iron, magnesium, mercury, nickel, potassium, selenium, silver, sodium, and VOCs. Additional sediment data are not necessary for ecological risk purposes for the following compounds in sediment: aluminum, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, vanadium and VOCs. Note that these data may still be collected for human health purposes but, consistent with the UAO and EPA guidance (EPA, 1997 and 2001), these compounds will not be carried forward in the BERA, if it is determined that a BERA is necessary.

As discussed at the August 4, 2005 Scoping Meeting, the SLERA and the resulting SMDP will be re-evaluated after a more complete database of soil and sediment samples collected during the RI has been developed. Steps 3 and possibly up through 7 of the ERA process, as described above, will be conducted if the updated SLERA indicates that further ecological evaluation is necessary. If further evaluation is necessary and additional ecological data are collected as part of Steps 4 and 5, these data will be included in the PSCR.

5.8 TASK 8: TREATABILITY STUDIES

Treatability testing will be performed, if required by EPA, to assist in the detailed analysis of remedial alternatives. In addition, if applicable, testing results and operating conditions shall be used in the detailed design of the selected remedial technology. Candidate technologies for a treatability studies program will be identified and the need for treatability testing will be considered as the RI/FS proceeds. Treatability studies may consist of laboratory screening, bench-scale testing, and/or pilot-scale testing. The specific data requirements for a treatability testing program will be determined and refined during the characterization of the Site and the development and screening of remedial alternatives.

Currently no treatability studies are anticipated; however, the following activities will be performed if the need for treatability testing is indicated:

5.8.1 Literature Survey

A literature survey will be conducted to gather information on performance, relative costs, applicability, removal efficiencies, operation and maintenance requirements, and implementability of candidate technologies. If practical technologies have not been sufficiently demonstrated or cannot be adequately evaluated for this Site on the basis of available information, the scope and objectives of a treatability testing program will be developed.

5.8.2 Treatability Study Work Plan

A Draft Treatability Study Work Plan (TSWP) proposing the type(s) of treatability study to be conducted (i.e., laboratory screening, bench-scale testing, and/or pilot-scale testing), and outlining the steps and data necessary to initiate and evaluate the treatability testing program will be submitted to EPA. As necessary, the TSWP will include a Sampling and Analysis Plan (SAP) and Health and Safety Plan. A Final TSWP will be submitted to EPA within 20 days of the receipt of the EPA's comments on the draft TSWP.

5.8.3 Treatability Study Report

Following completion of Treatability Study activities, a Draft Treatability Study (TS) Report will be submitted to the EPA for review and approval. The TS Report will evaluate the tested technology's effectiveness and implementability in relation to the PRGs established for the Site in the FS. Treatability study results will be compared with predicted results to justify effectiveness and implementability discussions. A Final TS Report will be submitted to EPA within 20 days of the receipt of the EPA's comments on the Draft TS Report.

5.9 TASK 9: REMEDIAL INVESTIGATION REPORT

A Draft Remedial Investigation (RI) Report will be submitted to EPA no later than 60 days following receipt of EPA approval of the PSCR. The RI Report format will be based on applicable guidance (EPA, 1988b) and will include a summary of the results of the field activities to characterize the Site, classification of groundwater beneath the Site, nature and extent of contamination, and appropriate site-specific discussions for fate and transport of contaminants. A Final RI Report will be submitted within 30 days of the receipt of the EPA's comments on the Draft RI Report.

The RI findings will be presented in a project meeting with EPA to be held within 15 days after submittal of the Final RI Report. Additional topics to be discussed at this meeting will include remedial action objectives, candidate technologies and remedy alternatives envisioned for the FS, and comparative analysis of these alternatives.

5.10 TASK 10: FEASIBILITY STUDY

A Feasibility Study (FS) Report will be will be prepared for the Site. The FS process includes the development and screening of alternatives for remedial action, a detailed analysis of alternatives for remedial action, submittal of Draft and Final FS Reports, and other reports/memoranda. At this early stage of the RI/FS process, potential remedial alternatives to be considered for the Site include treatment, removal and no action alternatives for those media (if any) identified as posing an unacceptable risk during the risk assessment. Specific FS activities include the following:

- A Draft Remedial Alternatives Memorandum (RAM) will be submitted for EPA review no later than 30 days following receipt of EPA approval of the Final PSCR. The RAM will describe the screening process used to develop remedial alternatives for each affected medium, particularly with regard to remedial action objectives and the PRGs. The RAM will also identify chemical, location, and action-specific ARARs for each of the alternatives. A Final RAM will be submitted within 15 days of receipt of EPA comments on the Draft RAM.

- A Draft FS Report will be submitted for EPA Review no later than 45 days after receipt of EPA approval of the Final RI Report. The FS Report will include a detailed analysis of remedial alternatives for the candidate remedies identified during the screening process based on EPA guidance (EPA 1988). The major component of the analysis of alternatives for remedial action will consist of an analysis of each option against CERCLA evaluation criteria (overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost). A comparative analysis of all options with respect to each other will also be provided.

_ An Interim Final FS Report will be submitted within 30 days of the receipt of EPA comments on the Draft FS Report. The FS Report shall provide the basis for the Proposed Plan developed by the EPA under CERCLA and shall document the development and analysis of remedial alternatives. The Interim-Final FS Report may be subject to change following comments received during the public comment period on the EPA's Proposed Plan. The EPA will forward any comments pertinent to the content of the Interim-Final FS Report to the Respondents. A Final FS Report will be submitted to EPA within thirty (30) calendar days of the receipt of these comments.

6.0 PROJECTED SCHEDULE

The projected schedule for conducting the RI/FS is shown on Figure 11. This schedule is subject to revision based on changes in assumed EPA review time periods, weather conditions, modifications or additions to the scope of work described herein based on the data obtained or delays in obtaining access to any properties to be sampled. As appropriate, this schedule will be periodically revised and included in Monthly Status Reports required under Paragraph 53 of the modified UAO.

7.0 PROJECT MANAGEMENT PLAN

The management organization for the RI/FS and the key personnel assigned to the project are shown on Figure 12, and the responsibilities of the key players on the project managerial team are described below. The responsibilities of the project management team members, along with identification of the key personnel assigned to the project, are described in the following sections.

7.1 RESPONDENTS' PROJECT COORDINATOR

The Respondents' Project Coordinator will provide the principal point of contact and control for matters concerning the project and field investigation implementation. In consultation with the Respondents, the Contractor Project Manager will:

- Coordinate field investigation activities and develop a detailed schedule;
- Establish project policies and procedures to meet the specific objectives of the project;
- Orient all field staff concerning the project;
- Develop and meet ongoing project staffing requirements, including mechanisms to review and evaluate each work product;
- Review the work performed on each project to help ensure its quality, responsiveness and timeliness; and
- Represent the project team at meetings and public hearings, if necessary.

7.2 REMEDIAL INVESTIGATION MANAGER

The RI Manager will direct and supervise all RI work. The RI Manager's responsibilities will be to review all RI project work to ensure that it meets the specific project goals, meets technical standards, and is in accordance with the objectives and procedures discussed in the RI/FS, FSP, QAPP and HSP.

7.3 RISK ASSESSMENT MANAGER

The Risk Assessment Manager will direct and supervise all risk assessment activities, including both human health and ecological risk assessment. The Risk Assessment Manager will provide input to the development of the RI work plans and will direct all risk-related data evaluation activities. The Risk Assessment Manager's responsibilities will be to ensure that all risk assessment work meets the specific project goals, meets technical standards, and is in accordance with the objectives and procedures discussed in the RI/FS, FSP, QAPP and HSP.

7.4 FEASIBILITY STUDY MANAGER

The FS Manager will direct and supervise all FS activities, including development and implementation of any treatability studies, assembling of remedial action alternatives and evaluation of these alternatives in the FS. The FS Manager's responsibilities will ensure that all FS activities meets the specific project goals, meets technical standards, and is in accordance with the objectives and procedures discussed in the RI/FS, FSP, QAPP and HSP.

7.5 QUALITY ASSURANCE MANAGER

The Quality Assurance (QA) Manager will remain independent of direct involvement in day-to-day operations, but will have direct access to staff, as necessary, to resolve any QA issues. The QA Manager has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA/QC issues. Specific functions and duties include:

- Performing QA audits on various phases of the project's operations, as necessary;
- Reviewing and approving the QAPP and other QA plans and procedures;
- Performing validation of data collected relative to RI/FS activities and the QAPP; and
- Providing QA technical assistance to project staff.

The QA Manager will notify the Project Coordinator of particular circumstances that may adversely affect the quality of data and ensure implementation of corrective actions needed to resolve nonconformances noted during assessments.

7.6 SITE SAFETY OFFICER

The Site Safety Officer (SSO) is the highest ranking safety officer. The SSO has the responsibility of ensuring that all personnel are properly trained and educated, that they abide by the specific health and safety policies, procedures and values contained in the HSP (PBW, 2005a). The SSO will be on call at all times field work is being conducted at the site and vicinity. The SSO will also perform on-site audits of work in progress.

7.7 FIELD SUPERVISOR

The Field Supervisor will be responsible for all aspects of field work performed as part of a specific RI/FS activity. Different project subtasks or activities may have different Field Supervisors. Duties of the Field Supervisor will include:

- Maintaining field records;
- Continually surveying the Site for potential work hazards and relating any new information to site personnel at the Tailgate Safety Meeting held each day prior to beginning field activities.
- Ensuring that field personnel are properly trained, equipped, and familiar with Standard Operating Procedures and the Health and Safety Plan;
- Overseeing sample collection, handling and shipping; ensuring proper functioning of field equipment; and
- Informing the laboratory when samples are shipped to the lab.

The primary duty of the Field Supervisor is to ensure that the field sampling is performed in accordance with the FSP and QAPP. The Field Supervisor will also require that appropriate personal protective equipment will be worn and disposed of according to the HSP. In addition, the Field Supervisor may be responsible for the preparing monitoring reports for review by the Project Coordinator.

8.0 DATA MANAGEMENT PLAN

Data management provides a process for tracing the path of the data from their generation in the field or laboratory to their final use or storage. The following elements are included in this process: recording, validation, transformation, transmittal, reduction, analysis, tracking, and storage and retrieval.

8.1 DATA RECORDING

Sample collection will be documented and tracked using field forms, field logbook entries, and Chain-of-Custody Records. Field personnel will complete these forms, which then will be reviewed for correctness and completeness by the Field Supervisor. Copies of these forms will be maintained in the project files.

8.2 DATA VALIDATION

Data validation is addressed in Section 5 of the QAPP.

8.3 DATA TRANSFORMATION

Since data will be collected and/or reported using proper units according to the QAPP, no data transformation is expected. If data transformation is necessary, the transformation procedures will be added to the QAPP.

8.4 DATA TRANSMITTAL

The Field Supervisor will be responsible for assuring that field data are entered onto the appropriate field data forms, and will report any problems to the RI Manager. Field Supervisors will submit the complete field data forms to the RI Manager for review and error checking.

Field Supervisors will also ensure that all samples collected in the field are submitted to the laboratory according to the methods outlined in the QAPP or the FSP. The laboratory will submit to the RI Manager or Field Supervisor the analytical data results in their standard hard-copy format (including raw data format) and in an electronic data deliverable (EDD) format prior to sending the final data report in Adobe format to the RI Manager. The EDD shall be in space or comma-delimitated ASCII format or in Excel spreadsheet format that will allow for easy integration into a digital database.

Once reviewed by the RI Manager or Field Supervisor for obvious transcription or reporting errors, the final data report in both hard-copy and EDD formats will be transmitted and ready for validation by the QA Manager. Following data validation, any data qualifiers added to data during the validation process will be imported into the project database. Entry or upload of EDDs and data qualifiers into the project database will be completed by a designee of the RI Manager. The data and qualifiers will be initially verified by the individual entering the data. Upon completion of the initial verification step, a report will be generated of the data and verified by the RI Manager against the original data. Only final versions of electronic data will be entered into the database. All electronic data will be verified before and after incorporation into the database against the hard copy reports that accompany the data.

All qualified data will be included with the data packages during all subsequent data transmittal processes. The final hard copy data validation checklists will be included with the data in the PSCR.

All field forms and lab data will be organized and stored by sample location allowing for easy access if needed. Data can be transferred electronically either on disc, CD, tape or as an email attachment.

8.5 DATA ANALYSIS

Data analysis will be conducted as described on an activity basis in Section 5.0 of this RI/FS WP. Applications that may be utilized to analyze the data include Microsoft Excel and Microsoft Access. The results of data analysis for each activity will be presented in the RI Report.

8.6 DATA STORAGE AND RETRIEVAL

PBW's RI Manager is responsible for project data storage and retrieval. Laboratory data that are stored electronically will be archived electronically, and where printed as part of the paper data report package, will also be archived in paper form. Both the electronic data and hard copies will be maintained in PBW's Round Rock, TX office. In general, all records and data must be retained for a period of 10 years following commencement of construction of any remedial action which is selected following completion of the RI/FS, per Section XX, Paragraph 79 of the UAO.

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